NORTHERN HARDWOODS CULL MANUAL

by

Savel B. Silverborg

State University of New York

COLLEGE OF FORESTRY

AT SYRACUSE

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Research Associate in Forest Pathology

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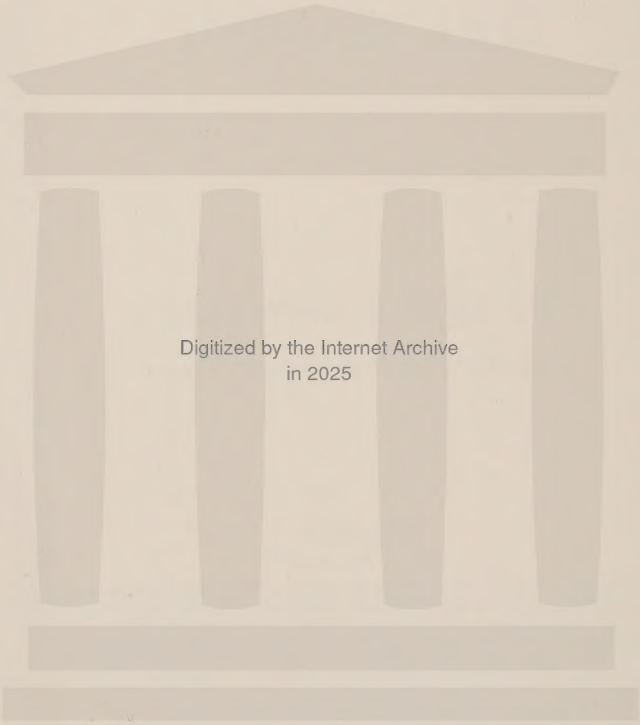
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INTRODUCTION

The increased drain of timber from our forests during the past decade necessitates closer utilization of our remaining standing timber if the present rate of harvest is to be maintained. Each year thousands of board feet of merchantable timber are left unharvested during logging operations because of the presence in many trees of certain outward evidences of cull. While many of these outward signs signify extensive cull, others indicate only a slight reduction in the merchantable volume. In order to determine which trees are profitable to harvest, a knowledge of estimating cull from external signs in standing trees is essential to timber cruisers, foresters, timber land managers, and farm woodlot owners.

In 1950 the State University of New York College of Forestry at Syracuse initiated extensive studies of cull in northern hardwoods in the Adirondack region of New York. Approximately 700 trees with various outward evidences of cull were felled and sectioned and the amount of cull measured. The trees selected for the study were mostly in the mature age classes.

Rules cannot be prepared for universal application because cull from any given cause varies with geographical location, site, rate of growth, amount of suppression, and other factors. The information in this manual represents average cull deductions for hardwoods in the Adirondack region of New York State.

Specific control measures for heartrots and cankers, two of the major causes of cull in northern hardwoods, are discussed on pages 42 - 44. Cull deductions for the various outward signs are summarized in a table on page 45.

HEARTROTS

Heartrot in living trees is usually indicated by the presence of external structures commonly known as sporophores, conks, or fruiting bodies. They are formed after decay has progressed in the tree for several years.

Each conk produces millions of tiny seedlike bodies, called spores, which may be carried great distances by air currents. If these spores come in contact with the exposed wood of a susceptible host, and moisture and temperature conditions are favorable, the spores germinate and send our fungus filaments which penetrate and feed on the wood and cause decay. The rot usually progresses only a few inches a year. Vertical growth of the decayed area is faster than radial growth.

Heartrot fungi commonly enter the tree through dead branch stubs, fire scars, logging injuries, and other bark wounds which expose the underlying wood. Typical heartrot fungi generally require exposed heartwood for entrance into the host.

Heartrots are commonly classified, according to the color of the decayed wood, as white rots and brown rots. Most of the common heartrots of northern hardwoods belong to the white rot group.

FOMES IGNIARIUS

(Fig. 1)

White trunk rot or white heartrot is caused by the fungus *Fomes igniarius* (L. ex Fries) Kickx., commonly known as the false tinder fungus. It is one of the most common causes of heartrot of aspen, beech, and other hardwoods in the Northeast. It is world-wide in distribution and occurs on practically all hardwood species.

Description of conks: The conks of the false tinder fungus are usually hoof-shaped. The upper surface of young conks is grayish-black to black and becomes rough and cracked with age. The lower, or spore-producing surface, is brown and frequently has a light gray, sterile, outer rim. The interior of the conk is rusty brown and consists of several layers of tubes: the older ones are often white-stuffed or incrusted.

Cull deductions: A single sporophore of *Fomes igniarius* on beech and hard maple indicates a decay column approximately 6 to 7 feet both above and below the conk. On yellow birch, the decay column extends up and down approximately 8 to 10 feet from the conk. The fruiting bodies are often located near the middle and lower portions of the trunk. Thus, a single conk may indicate extensive reduction in merchantable volume.

Fig. 1. Conk of *Fomes igniarius* growing through branch scar on trunk of beech

FOMES APPLANATUS

(Fig. 2)

Fomes applanatus (Pers. ex Fries) Gill., commonly known as the artist's conk, causes a white mottled rot in many hardwood species. Although it occurs most frequently on dead timber, this fungus also causes decay of the sapwood and heartwood of living trees, particularly beech and hard maple. Artist's conks are generally associated with basal wounds.

Description of conks: The sporophores of *Fomes applanatus* are perennial and shelflike. The thick, horny upper surface is gray to grayish-brown and contains numerous concentric layers. The lower surface is white when fresh but yellows with age. When fresh, the lower surface is easily bruised and turns brown when scratched. Because of this, it is commonly used for sketching by amateur artists. The interior of the conk is dark brown and is separated into distinct layers of tubes by thin strips of brownish fungous tissue.

Cull deductions: A single sporophore of *Fomes applanatus* indicates a decay column extending approximately 1 to 6 feet both above and below the conk.

Fig. 2. Sporophore of *Fomes applanatus* on base of beech

FOMES CONNATUS

(Fig. 3)

Fomes connatus (Weinm.) Gillet causes a soft, white heartrot of several hardwoods, primarily hard maple and red maple. The conks appear most frequently on the lower portion of the bole, usually in seams or basal scars. Occasionally, however, the sporophores are found as high as 8 to 12 feet on the trunk.

Description of conks: The sporophores of *Fomes connatus* are perennial, white, and relatively small. Usually they are less than 6 inches wide, 2 to 4 inches thick, and project 1 to 4 inches from the trunk. Several conks attached to a common base often occur in a series one above the other. Actively growing sporophores are soft, spongy, and water-soaked. A normally reliable identification characteristic is the presence of moss on the upper surface.

Cull deductions: Conks of *Fomes connatus* usually indicate only limited decay, since the fruiting bodies are generally located on the lower portion of the bole. In hard maple the decay column extends approximately 2 to 4 feet both above and below the conk. The extent of decay in red maple is approximately 3 to 5 feet both up and down from the conk.

Fig. 3. *Fomes connatus* fruiting in basal scar of hard maple

FOMES FOMENTARIUS

(Fig. 4)

Fomes fomentarius (Fr.) Kickx., commonly known as the tinder fungus, causes a white mottled rot of sapwood and heartwood of beech, birches, hard maple, and other hardwoods. This fungus is primarily a destroyer of dead timber, being one of the most common scavengers in hardwood forests, but it occasionally occurs on living trees.

Description of conks: The conks of the tinder fungus are perennial and hoof-shaped. They have a smooth, gray to brown, concentrically zoned upper surface which frequently extends below the plane of the spore-producing surface, forming a thin sterile rim. The under surface is grayish-brown, with relatively large round pores. The interior of the conk is dark brown and punky. It was used by Indians and woodsmen in the early days to carry fire from one place to another; hence the name tinder fungus.

Cull deductions: A single sporophore of the tinder fungus indicates a decay column extending approximately 1 to 5 feet both above and below the conk. However, the rot is usually limited to one-half of the cross-sectional area of the trunk.

Fig. 4. Conks of *Fomes fomentarius* on trunk of yellow birch

STERILE CONKS

Sterile conks, as the name implies, are specialized, non-fertile fungous growths. They are rough, black to brown, clinker-like masses of fungous tissue (Fig. 7, 8) occurring around dead branch stubs, wounds, or cankers of living trees. They cause serious heartrot in beech, hard maple, red maple, yellow birch, and white birch.

In addition to protruding clinker-like types of sterile conks, cankers (Fig. 6A) consisting of sterile fungous tissue often develop around branch scars and as sunken areas on the trunk, resulting from the rot extending through the sapwood. Black, clinker-like fungous material frequently breaks through the face of older cankers.

Sterile conks and cankers usually occur on living trees, while the fertile fruiting bodies (Fig. 6) develop on down trees or logs which have been in contact with the forest floor for several years. The fertile sporophores develop in the same general area on the down trees or logs as the sterile forms.

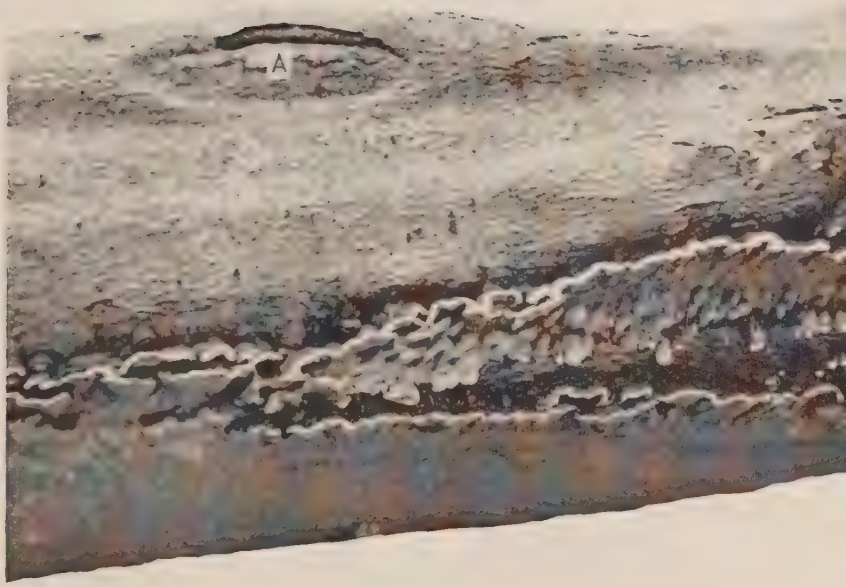

Fig. 6. Fertile sporophores of *Polyporus glomeratus* on lower half of partially-decayed beech log; (A) Canker consisting of sterile fungous material caused by the rot growing out through the sapwood

STERILE CONK OF BIRCHES

(Fig. 8)

The sterile conk of birches, which also occurs infrequently on alder and ironwood, is caused by the fungus *Poria obliqua* (Pers.) Bres. The conks develop in trunk wounds, branch stubs, and on the face of old Nectria cankers. This fungus is a major cause of heartrot of yellow birch and white birch in the Adirondack region. The rot is very similar to that caused by *Fomes igniarius*.

Description of conks: When the conks first break through the bark, they are smooth and yellowish-brown in color. They soon become rough, black, brittle, and clinker-like. The conks vary in shape and size. Some are round at the base and range from a few inches to a foot or more in diameter and protrude up to 12 inches from the trunk. Others are narrow and frequently several feet long. Fragments of birch bark are often imbedded in the sterile conk tissue.

Cull deductions: Sterile conks of *Poria obliqua* on birches indicate extensive heartrot. The upward and downward extent of decay from a conk is approximately 5 to 7 feet.

Fig. 8. Sterile conk of *Poria obliqua* on yellow birch

STERILE CONK AND CANKER OF MAPLES

(Fig. 9)

The sterile conk and canker of hard maple and red maple is caused by the fungus *Polyporus glomeratus*. This conk or canker is difficult to recognize but is one of the most serious causes of heartrot in hard maple and red maple in the Adirondack region. The associated heartrot is white to light-brown and spongy and contains numerous particles of black, gritty material. The rot is usually limited to a relatively small central core of heartwood. The fungus enters the tree primarily through branch stubs. Abnormal callous tissue forms around the infected branch stubs, resulting in prominent swollen woody knobs.

Description of conks and cankers: As the fungus progresses upward and downward from the infected branch stubs, additional swollen knobs may develop at branch stubs along the main trunk. Frequently, oval to long sunken cankers develop as a result of the fungus growing outward and killing the sapwood and cambium. Black, sterile, clinker-like fungous material breaks through the face of the cankers in older infections.

Cull deductions: Conks and cankers caused by *Polyporus glomeratus* on hard maple indicate a decay column extending approximately 5 to 7 feet both above and below the conks or cankers. In red maple the upward and downward extent of decay is approximately 6 to 8 feet.

Fig. 9. *Polyporus glomeratus* canker on hard maple

CANKERS

Cankers are localized diseased areas of the bark of branches and trunks of living trees and are usually caused by fungi. Three cankers are common on hardwoods in the Adirondack region: Nectria canker, Eutypella canker, and Hypoxylon canker.

NECTRIA CANKER

(Fig. 10)

Nectria cankers occur on many hardwoods in most of the temperate regions of the world. On most hardwoods they are caused by the fungus *Nectria galligena* Bres. In the Adirondack region, Nectria cankers are commonly found on yellow birch, basswood, and cherry, and less frequently on other hardwoods.

Description of cankers: In the early stages of development, Nectria cankers are difficult to recognize. The first evidences are dark, flattened or depressed areas, usually water-soaked in appearance, occurring around small branches or near wounds. Cracks generally develop on the outer margins of young cankers. Older cankers are usually oval or elliptical, target-shaped areas with definite callous ridges resulting from killing back of successive folds of healing tissue.

Cull deductions: Reduction in merchantable volume is primarily due to cankers being located on the most valuable portion of the trunk. Also, affected trees are weakened at the cankers and subject to wind breakage. Decay caused by wood-rot fungi is occasionally associated with Nectria cankers. However, the rot does not generally extend more than 1 foot beyond the vertical limits of the canker.

Fig. 10. Nectria canker on trunk of young black cherry

EUTYPELLA CANKER

(Fig. 11)

A common trunk canker of hard maple and red maple, which also occurs infrequently on boxelder, is caused by the fungus *Eutypella parasitica* Dav. & Lor. This canker often causes serious losses in hardwood stands containing a high proportion of hard maple and red maple. Cankered trees less than 5 inches in diameter are sometimes killed, while those 5 inches or more in diameter are rarely killed.

Description of cankers: Eutypella cankers are characterized by firmly attached bark and broad, slightly raised rings of callous tissue. The central or older portions of cankers contain numerous minute, short, black, bristle-like projections which are the necks of fruiting bodies. Another characteristic feature is the presence of white to buff-colored, fanlike growths underneath the bark at the edges of the cankers.

Cull deductions: Reduction in merchantable volume is due primarily to wind breakage and to the fact that the cankers are generall located on the most valuable portion of the trunk, making it partially or completely unmerchantable. Decay is often associated with Eutypella cankers but rarely extends more than 1 foot above and below the vertical limits of the canker.

Fig. 11. Eutypella canker on hard maple

HYPOXYLON CANKER

(Fig. 12)

A serious canker of quaking aspen, largetooth aspen, and less frequently of balsam poplar is caused by the fungus *Hypoxylon pruinatum* (Klotzsch) Cke. It is widely distributed in southern Canada from Nova Scotia to Alberta and in the United States from Massachusetts to Minnesota.

Description of cankers: The disease is most serious on trees less than 30 years old. The first evidences are yellow to reddish-brown, slightly sunken areas occurring around wounds and dead branch stubs. Older cankers become mottled, and black patches of inner bark tissue are exposed. Vertical cracks develop at the edges of the cankers.

Blister-like areas occurring on one- or two-year-old cankers are caused by short, pillar-like structures, the asexual fruiting stage, growing beneath the thin outside layers of bark. The sexual fruiting stage develops on cankers that are 3 years old or more. They appear as flattened to somewhat protruded black clusters with a white coating which disappears with age.

Cull deductions: Cankered trees usually indicate 100 per cent cull unless they are harvested soon after they become affected.

Fig. 12. Hypoxylon canker on largetooth aspen

SEAMS

Seams are long vertical or spiral cracks on tree trunks. They vary in size from a few feet to the entire length of the trunk. These cracks, which are usually caused by wind, lightning, or frost, occur in all species. However, they are observed most frequently in beech because of its smooth bark.

Seams may be classified as straight, spiral, and infolding. Infolding seams usually indicate extensive cull, but straight and spiral seams are not generally associated with decay.

Cull deductions:

1. *Straight seams* (Fig. 13) generally indicate less than 5 per cent cull.
2. *Spiral seams* (Fig. 14) may indicate varying amounts of cull, depending on the ultimate manufactured product. If long, clear lengths are required, spiral-seam logs may indicate up to 100 per cent cull. However, for certain specialty uses requiring short, clear lengths, spiral-seam logs may be utilized almost completely.
3. *Infolding seams* (Fig. 15) usually indicate 100 per cent cull.

Fig. 13. Straight seam on beech

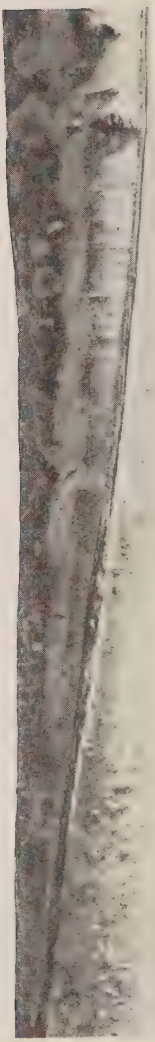

Fig. 14. Spiral seam on beech

Fig. 15. Infolding seam on beech

BUTT SCARS

(Fig. 16)

Butt scars are triangular-shaped openings at the base of trees and are commonly caused by fire and logging injuries. The exposed wood in the scars is susceptible to attack by heartrot fungi. In advanced stages of decay, butt-scarred trees may be weakened sufficiently to be subject to wind breakage.

Cull deductions: Butt scars in beech and sugar maple indicate decay extending approximately 3 to 5 feet above the top of the scar. Butt scars in yellow birch usually indicate 12 to 14 feet of decay.

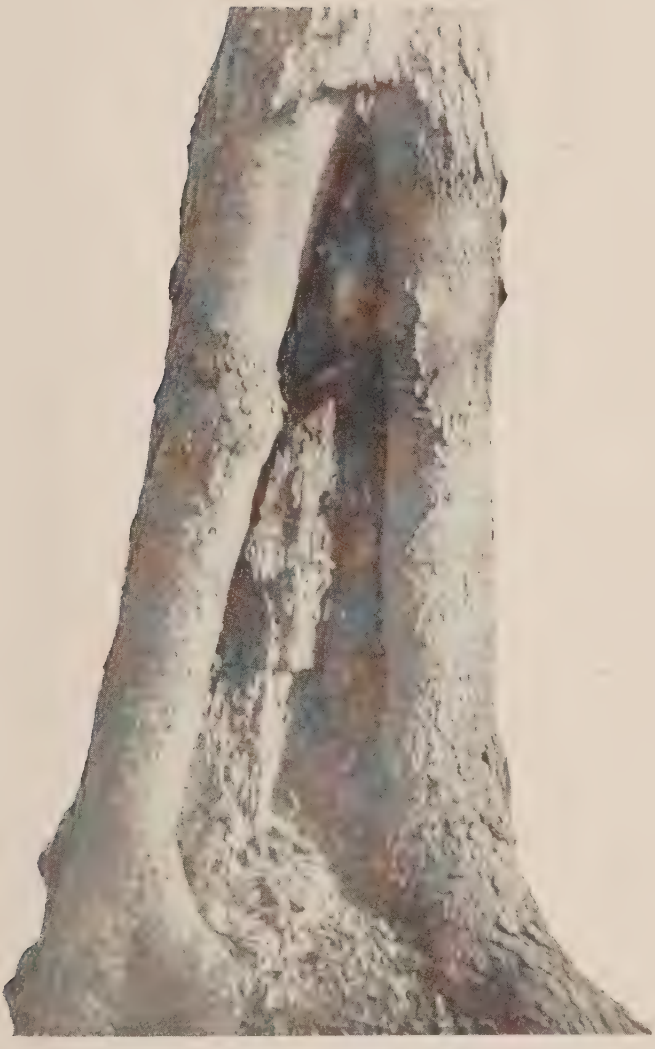

Fig. 16. Butt scar caused by fire on base of hard maple

BUTT BULGES

(Fig. 17)

Butt bulges, swellings at the base of trees, are usually caused by an injury or by decayed branches which were imbedded in the trunk at an early age. They occur commonly in sugar maple and yellow birch, and less frequently in beech.

Cull deductions: Butt bulges in hard maple and beech indicate decay extending approximately 3 to 5 feet above the top of the bulge. In yellow birch, butt bulges usually indicate 12 to 14 feet of decay.

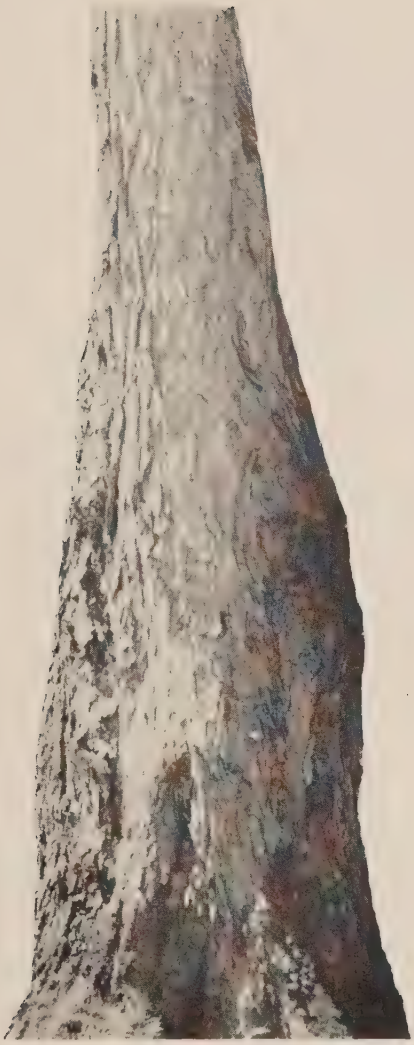

Fig. 17. Butt bulge on hard maple

STEM BULGES

(Fig. 18)

Stem bulges are either round or relatively long enlargements of the upper portion of the stem. They are commonly associated with wounds, rotten branches, branch holes, and other injuries. Rotten branch stubs are frequently found imbedded in the center of the swellings. Stem bulges are common in hard maple, less frequent in yellow birch, and rare in beech.

Cull deductions: Stem bulges in hard maple usually indicate decay extending only to the vertical limits of the bulge. In yellow birch, decay is more extensive, often extending 5 to 6 feet both above and below the vertical limits of the swelling.

Fig. 18. Stem bulge on hard maple

ROTTEN BRANCHES

(Fig. 19)

Small, rotten branches up to 3 inches in diameter generally indicate only limited decay. In hard maple and beech, the total vertical extent of decay is usually 1 foot or less. In yellow birch, decay generally extends between 1½ to 2 feet.

Larger rotten branches more than 3 inches in diameter indicate 1 to 1½ feet of decay in hard maple and beech, and 2 to 5 feet in yellow birch.

Fig. 19. Rotten branch on yellow birch

BURLS

(Fig. 20)

Burls, also commonly known as galls, are round to semi-round or elongate swellings of the trunk and branches of living trees. They may range in size from a few inches to several feet long. Although some are of unknown origin, many are caused by insects, fungi, bacteria, or an injury. Burls of unknown cause occur frequently on yellow birch and less commonly on other hardwoods in the Adirondack region.

Decay is not usually associated with the type of gall on yellow birch (Fig. 20). However, trees with trunk galls should not be raised as crop trees because the wood in the vicinity of the galls is cross-grained, distorted, and weak. Except for certain novelty uses, the wood in the galls has no commercial value.

Fig. 20. Burl on trunk of yellow birch

CONTROL OF HEARTROTS

Since it is impossible to completely control heartrot in forest stands, the primary objective of any control program should be to reduce the amount of damage. This may be accomplished in a number of ways:

1. *Prevention of wounds.* Wounds resulting from fire, improper use of power logging equipment, poor logging practices, and other causes serve as common avenues of entrance for wood-rotting fungi. Therefore, any measures to reduce wounding will help to lessen losses due to decay.

2. *Proper handling of sprout stands.* Trees originating from sprouts are generally more susceptible to decay than those of seedling origin. The information presented here was derived from studies in sprout oak stands by Hepting and Roth[1] and Roth and Sleeth[2]. Similar observations also have been made by the author in northern hardwood stands of sprout origin.

   The decay hazard is less in sprouts originating from small stumps 1 inches or less in diameter at the ground line. The larger the parent stump, the more likelihood of decay in the sprouts. Sprouts originating from low stumps should be favored over sprouts from high stumps.

   Twin hardwood sprouts frequently present a thinning problem during stand improvement work. Twin sprouts over 3 inches in diameter and with the union well above the ground line should either be left uncut or both should be removed. If only one is removed, the exposed heartwood will increase the decay hazard to the remaining one. In twin sprouts with the union close to the ground line, either

[1] E. R. Roth and G. H. Hepting, "Origin and Development of Oak Stump Sprouts as Effecting their Likelihood of Decay," *Journal of Forestry*, 41 (1943a), 27-36.

[2] E. R. Roth and B. Sleeth, Butt Rot in Unburned Sprout Oak Stands. (U.S.D.A. Tech. Bul. No. 684. [Washington, D. C., 1939]).

sprout may be removed without appreciably increasing the decay hazard to the remaining one.

3. *Reduction of inoculum (spores).* During stand improvement work, it is generally recommended that trees bearing sporophores be removed or girdled. If the conks continue to develop on felled or girdled trees, the trunks should be removed from the stand. Hirt[3] recommends removing and disposing of birch and beech trees bearing sterile conks so that the fungi will not produce the fertile sporophores on dead wood.

4. *Proper selection of crop trees.* Trees should be carefully selected during stand improvement work to assure an economically profitable final crop. Trees with butt or trunk wounds should be removed if practical. While the amount of rot may be insignificant at the time the improvement work is done, it may become serious before the final harvest is made.

   Trees with cankers, fertile conks, swollen branches, and other external evidences of cull should be either removed or girdled. They occupy valuable space in a stand and hinder the growth of more desirable crop trees and young growth which will eventually make up the final stand.

[3] Ray R. Hirt, "Decay of Certain Northern Hardwoods by *Fomes igniarius*, *Poria obliqua* and *Polyporus glomeratus*," Phytopathology 34 (1949), 475-80.

CONTROL OF CANKER DISEASES

Although it is impossible to completely eradicate cankers from heavily infected stands, spore production and subsequent damage can be minimized by reducing the number of cankered trees. These trees can be removed most economically during regular silvicultural stand improvement work. If possible, cankered trees should be utilized as fuelwood.

If it is not practical to remove cankered trees from a stand, infected trees should be felled or girdled. However, these methods will not assure satisfactory control. Many canker-forming fungi will live as saprophytes and continue to produce spores on felled or girdled trees for several years, and thus be a constant threat to the remaining trees in a stand.

Control measures should be practiced primarily in young hardwood stands. If cankered trees are continually removed during periodic silvicultural operations, the final result will be a stand of practically canker-free crop trees.

Present indications are that cankers are more prevalent on poor sites than on good sites. Therefore, it is not economically justifiable to practice stand improvement work for the eradication of cankered trees on poor hardwood sites.

Cull Indicator	SPECIES AND EXTENT OF CULL					
	Beech		Hard Maple		Yellow Birch	
	Decay Upward (ft.)	Decay Downward (ft.)	Decay Upward (ft.)	Decay Downward (ft.)	Decay Upward (ft.)	Decay Downward (ft.)
Conks						
Fomes igniarius	6 to 7	6 to 7	6 to 7	6 to 7	8 to 10	8 to 10
Fomes applanatus	4 to 6	4 to 6	4 to 6	4 to 6	.....	.....
Fomes connatus	.....	.....	2 to 4	2 to 4	.....	.....
Fomes fomentarius	4 to 5	4 to 5	4 to 5	4 to 5	4 to 5	4 to 5
Ustilina vulgaris	3 to 4	.....	3 to 4	.....	.....	.....
Sterile conks						
Beech	5 to 6	5 to 6	.....	.....	.....	.....
Birch	.....	.....	.....	.....	5 to 7	5 to 7
Maple	.....	.....	5 to 7	5 to 7	.....	.....
Cankers						
Nectria[1]	.....	.....	.....	.....	.....	.....
Eutypella	.....	.....	½ to 1	½ to 1	.....	.....
Hypoxylon[2]	.....	.....	.....	.....	.....	.....
Seams[3]						
Straight	0 to 5%		0 to 5%		0 to 5%	
Spiral[4]	.....		.....		.....	
Infolding	100%		100%		100%	
Butt Scars	3 to 5	.....	3 to 5	.....	12 to 14	.....
Butt Bulges	3 to 5	.....	3 to 5	.....	12 to 14	.....
Stem Bulges	.....	.....	[5]	[5]	5 to 6	5 to 6
Rotten branches[6]						
1 to 3 in. dia.	½ to 1		½ to 1		1½ to 2	
over 3 in. dia.	1 to 1½		1 to 1½		2 to 5	

[1] See page 22. [2] See page 26. [3] Decay expressed in per cent. [4] See page 28. [5] See page 36. [6] Decay expressed as total vertical length.

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